Date : 08/01/2013

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA
Sub : HUM 211 (Sociology)
Full Marks : 140 Time : 3 Hours
The figures in the margin indicate full marks.
USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION - A
There are FOUR questions in this section. Answer any THREE.

1. (a) Define sociology. 'Sociology is a categorical and not a normative discipline' - discuss. (10)
   (b) What are the underlying factors that contributed to the development of sociology as an independent discipline? (13½)

2. (a) 'Ethnocentrism is a habit to judge other ways of life by the standards of our own group' - explain. (10)
   (b) Define culture. Make a comparison between culture and civilization. (13½)

3. (a) What is social stratification? Explain the nature of estate system of social stratification. (10)
   (b) Discuss Marxist theory of social stratification. (13½)

4. Write short notes on any three of the following:
   (a) Types of socialization
   (b) Cultural transmission theory of deviant behaviour.
   (c) Cooley's looking glass self theory
   (d) White collar crime. (23½)

SECTION - B
There are FOUR questions in this Section. Answer any THREE.

5. (a) What is globalization? Discuss the salient features of globalization in modern life. (10)
   (b) 'Globalization is needed to get trapping free world' Elucidate it. (13½)

6. (a) What do you mean by demography? What are the necessities of studying population? (10)
   (b) Critically discuss the Malthusian theory of population. (13½)

7. (a) Elaborate the socio-economic factors of social change. (10)
   (b) What do you mean by industrial revolution? Discuss the social effects of industrial revolution. (13½)

Contd ......... P/2
8. Write short notes on any three of the following: (23/\)

(a) Population pyramid  
(b) Causes of migration  
(c) Mega city  
(d) Features of capitalism.
SECTION - A

There are FOUR questions in this Section. Answer any THREE.

1. (a) Using a constant Voltage-drop model for the diodes, find the output voltage $V_0$ for the circuit given in Fig. 1(a).

(b) Draw a bridge rectifier circuit. What are the advantages of a bridge rectifier circuit?

(c) Assuming the diodes to be ideal, find the values $I$ and $V$ in the circuit of Fig. 1(c).

2. (a) For a process technology for which $L_{min} = 0.4 \, \mu m$, $tox = 8 \, nm$, $\mu_n = 450 \, \mu m^2/V\cdot sec.$ and $V_t = 0.7 \, v$,

   (i) Find $Cox$ and $K_f$.

   (ii) The overdrive voltage required to operate a transistor having $\frac{W}{L} = 20$ in saturation with $I_D = 0.2 \, mA$.

   (b) For the input given as $V_{in}$, find the voltage $V_{out}$ for the circuit given in Fig. 2(b).

   Given, $V_t = 1 \, v$

   $K_f = 100 \, \mu A/V^2$, $\frac{W}{L} = 32$
3. (a) For the input voltage given as $V_{in}$ find and draw the output voltage $V_{out}$ for the circuit of Fig. 3(a). Also draw the waveshape of the collector current.

(b) Draw a three phase full wave rectifier and discuss its operation with neat sketches of the input and output voltage wave shapes.

4. (a) Draw the I-V characteristics of an SCR and discuss its operation.
(b) What are the differences between a rectifier and an inverter? Draw the circuit diagram for a single phase current source inverter using two SCRs.
(c) For a Bridge rectifier of Fig. 4(c) show that the peak diode current is $(v_s - 2v_d)/R$. Now, if $R = 1$ kΩ and $v_d = 0.7$ V what will be the PIV and peak diode current of this circuit.
6. (a) Explain the generation of a rotating magnetic field in a synchronous machine. Show that the magnetic field will have the same magnitude of 1.5 Bm at any time t.

(b) What are the conditions required for paralleling AC generators.

(c) A system consists of two generators supplying a load. Generator 1 has a no-load frequency of 62 Hz and a slope S1 of 1 MW/Hz. Generator 2 has a no load frequency of 61 Hz and a slope S2 of 1 MW/Hz. The two generators are supplying a real load totaling 2.5 MW at 0.8 pf lagging. Find the system frequency and the amount of power supplied by each generator to the load.

7. (a) Consider an isotropic antenna fed with a transmit power P_t. Find the equation for SNR of the received signal. Assume all the necessary constants.

(b) Define noise figure. Show that for a radar,

\[ \text{SNR} = P_t + 2G + 20 \log \lambda + \sigma - L - 30 \log 4 \pi - 40 \log r - 10 \log K + 30 \log 1 + 10 \log 4a - 40 \log r - 10 \log K + 10 B - F. \]

(c) From the radar equation derive the expression for maximum range of a radar.

8. (a) From the basic assumption derive the steinmetz equivalent circuit model for induction motor.

(b) Prove that \( P_{gen} = \frac{2 \omega P_{el}}{s} \)

(c) A three-phase, 5-hp, 60 Hz, 115-V, four pole induction motor operating at rated voltage, rated frequency and 125 percent rated load has an efficiency of 85.4 percent. The stator conductor loss, rotor conductor loss, and core loss are 223.2 W, 153 W and 114.8 W, respectively. Sketch the power-flow diagram, enter the given data and determine (a) Shaft speed, (b) Shaft torque (c) Loss in torque due to the combined friction, windage and stray power.
SECTION - A

There are FOUR questions in this Section. Answer any THREE.

1. (a) Draw and discuss the flow pattern obtained from the combination of a doublet and uniform flow. (10)
   (b) Establish the equation for the kinetic energy in a fluid due to a moving cylinder. (20)
   (c) Explain what you mean by the added virtual mass of a solid moving through a fluid. (5)

2. (a) Explain what you mean by 'analytic functions' and 'singular points'. Give some examples. (20)
   (b) Derive the Cauchy-Riemann equations. Discuss the significance of these equations with particular reference to irrotational flow. (15)

3. (a) State and prove Blasius’s theorem. (25)
   (b) Draw the pattern of flow for the transformation \( w = 5z^2 \). Determine the magnitude and direction of the velocity at the point (3, 2). (10)

4. (a) Explain with examples what you mean by flow past a half-body. (5)
   (b) Derive the equation of the half-body profile and thence find expressions for the half-width of the body, the velocity components and the pressure at any point in the flow. (20)
   (c) Draw and discuss the spiral flow pattern resulting from the combination of a source and a vortex. (10)

SECTION - B

There are FOUR questions in this Section. Answer any THREE.

5. (a) Prove that in an ideal fluid the pressure at a point is the same in all directions, even if the fluid is accelerating. (15)
   (b) What do you mean by irrotational flow? Derive the condition of irrotationality in three-dimensional flow. (20)

Contd .............. P/2
6. (a) The velocity at the boundary of a cylinder immersed in a fluid is \( V = 2U \sin \theta \) where \( U \) is the undisturbed velocity of the fluid and \( \theta \) is measured from the direction of flow. If the pressure in the undisturbed flow is \( P_0 \), determine the pressure distribution around the cylinder, the location of the stagnation points and the stagnation pressure. (20)

(b) Prove that the flow rate between any pair of streamlines in two-dimensional flow is numerically equal to the difference in their \( \Psi \) values. (15)

7. (a) Determine the stream function for parallel flow with a velocity \( V \) inclined at an angle \( \alpha \) to the x-axis. (15)

(b) Derive the Bernoulli equation after integration of the Euler equation along the streamline. (20)

8. (a) Derive the equation of the velocity profile for parallel viscous flow between two fixed parallel plates. (15)

(b) What do you mean by displacement thickness? A flat plate is immersed, parallel to the direction of flow, in water at 70°F, flowing at 8 ft/sec. Estimate the length of the laminar section of the boundary layer and the boundary layer thickness, at distance of one inch, one foot and ten feet from the loading edge. \( y = 1.06 \times 10^{-3} \) ft²/sec. (20)
SECTION A

There are four questions in this section. Answer any three.

1. (a) Mention the types of joints needed for different plate thicknesses in brazing. (05)
   (b) Briefly describe the electroslag welding process. Also mention its advantages and disadvantages. What are the differences between 'Electroslag' and 'Electrogas' welding? (20)
   (c) Give a short description of the 'Ion theory' of the arc column in shield Arc Welding. (10)

2. (a) Briefly discuss the modes of metal transfer in GMAW. (10)
   (b) Discuss the possible causes and corrective measures for 'Wire burnback' and 'Burn through' in GMAW. (10)
   (c) Briefly discuss the preparation of 'Aluminum', 'Stainless Steel', 'Mild Steel' and 'Titanium' for TIG welding. (15)

3. (a) Discuss the risks involved in 'Underwater welding'. What are chemical compositions of underwater welding electrodes? (10)
   (b) Give a short description of various spot welding methods. (10)
   (c) Write short notes on:
      (i) Welding torches.
      (ii) Types of flames in oxyacetylene welding
      (iii) Seam welding. (15)

4. (a) Discuss the factors that influence the choice of a particular welding process. (10)
   (b) Describe the operational procedure of Brazing. (15)
   (c) What are the purposes of using flux covered electrodes? According to British standard, what does E5132 mean? (10)

Contd ........ P/2
NAME 225

SECTION - B
There are FOUR questions in this Section. Answer any THREE.

5. (a) Define NDT. How can you determine a suitable NDT method for ship hull steel welds?  (10)
(b) What are the limitations of visual inspection technique?  (6)
(c) List some advantages of ultrasonic testing.  (7)
(d) Briefly discuss about magnetic particle testing.  (12)

6. (a) Mention some safety precautions for gas cutting operation.  (8)
(b) With a neat sketch, show the components of an oxygas cutting outfit.  (10)
(c) Briefly describe the cutting technique of a cast iron specimen.  (10)
(d) What are the basic differences between a cutting torch and a welding torch?  (7)

7. (a) With neat sketches, explain various types of tee joints and corner joints.  (7)
(b) Differentiate between backhand welding and forehand welding.  (6)
(c) Briefly discuss various measures to control welding distortions caused by expansion and contraction.  (15)
(d) Write a short note on 'Blast cleaning'.  (7)

8. (a) Explain with necessary sketch, the elements of a welding symbol.  (10)
(b) Discuss the applications of carburizing flame and oxidizing flame for cutting.  (7)
(c) Calculate the direct material cost for butt welding two mild steel plates each 300 mm × 150 mm × 4 mm. Assume that

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filler rod diameter</td>
<td>3 mm</td>
</tr>
<tr>
<td>Filler metal lost during welding</td>
<td>15%</td>
</tr>
<tr>
<td>Oxygen consumption</td>
<td>0.55 cu.m/hr</td>
</tr>
<tr>
<td>Acetylene consumption</td>
<td>0.27 cu.m/hr</td>
</tr>
<tr>
<td>Filler rod length consumed</td>
<td>3.4 m/m of weld</td>
</tr>
<tr>
<td>Welding time/metre of weld</td>
<td>20 min.</td>
</tr>
<tr>
<td>Density of filler metal</td>
<td>7.2 gm/cc</td>
</tr>
<tr>
<td>Cost of filler metal</td>
<td>Tk. 15/kg</td>
</tr>
<tr>
<td>Cost of oxygen</td>
<td>Tk. 5/cu.m</td>
</tr>
<tr>
<td>Cost of acetylene</td>
<td>Tk. 40/cu.m</td>
</tr>
</tbody>
</table>

(18)
NAME 225

SECTION – B

There are FOUR questions in this Section. Answer any THREE.

5. (a) Define NDT. How can you determine a suitable NDT method for ship hull steel welds?  
(b) What are the limitations of visual inspection technique?  
(c) List some advantages of ultrasonic testing.  
(d) Briefly discuss about magnetic particle testing.

6. (a) Mention some safety precautions for gas cutting operation.
(b) With a neat sketch, show the components of an oxygas cutting outfit.
(c) Briefly describe the cutting technique of a cast iron specimen.
(d) What are the basic differences between a cutting torch and a welding torch?

7. (a) With neat sketches, explain various types of tee joints and corner joints.
(b) Differentiate between backhand welding and forehand welding.
(c) Briefly discuss various measures to control welding distortions caused by expansion and contraction.
(d) Write a short note on 'Blast cleaning'.

8. (a) Explain with necessary sketch, the elements of a welding symbol.
(b) Discuss the applications of carburizing flame and oxidizing flame for cutting.
(c) Calculate the direct material cost for butt welding two mild steel plates each 300 mm × 150 mm × 4 mm. Assume that

<table>
<thead>
<tr>
<th>Filler rod diameter</th>
<th>3 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filler metal lost during welding</td>
<td>15%</td>
</tr>
<tr>
<td>Oxygen consumption</td>
<td>0.55 cu.m/hr</td>
</tr>
<tr>
<td>Acetylene consumption</td>
<td>0.27 cu.m/hr</td>
</tr>
<tr>
<td>Filler rod length consumed</td>
<td>3.4 m/m of weld</td>
</tr>
<tr>
<td>Welding time/metre of weld</td>
<td>20 min.</td>
</tr>
<tr>
<td>Density of filler metal</td>
<td>7.2 gm/cc</td>
</tr>
<tr>
<td>Cost of filler metal</td>
<td>Tk. 15/kg</td>
</tr>
<tr>
<td>Cost of oxygen</td>
<td>Tk. 5/cu.m</td>
</tr>
<tr>
<td>Cost of acetylene</td>
<td>Tk. 40/cu.m</td>
</tr>
</tbody>
</table>
SECTION – A

There are FOUR questions in this section. Answer any THREE.

1. (a) Form a PDE by eliminating the arbitrary function $\phi$ from

$$\phi(x + y + z, x^2 + y^2 - z^2) = 0.$$ What is the order of this PDE?

(b) Solve

$$(x^3 + 3xy^2)p + (y^3 + 3x^2y)q = 2z(x^3 + y^3).$$

(c) Find the complete and singular integral (if exists) of $q = (z + px)^2$.

2. Solve the following higher order differential equations:

(a) $$(D^2 + 2D_xD_y + D_y^2)z = 2\cos y - x\sin y.$$ 

(b) $$(D^2 - D_xD_y - 2D_x^2 + 2D_x + 2D_y)z = e^{2x+y} + \sin(2x + y) + xy.$$ 

(c) $$
(x^2D_x^2 - y^2D_y^2 + xD_x - yD_y)z = \ln x. $$

3. (a) What do you mean by inverse of a matrix? For the matrix $A = \begin{bmatrix} 3 & -3 & 4 \\ 2 & -3 & 4 \\ 0 & 1 & 1 \end{bmatrix}$ verify that $A(adjA) = |A|I_3$. Find the inverse of $A$ as well.

(b) Find the rank of the matrix $A = \begin{bmatrix} 2 & -1 & 3 & 4 \\ 0 & 3 & 4 & 1 \\ 2 & 3 & 7 & 5 \\ 2 & 5 & 11 & 6 \end{bmatrix}$ by reducing it to canonical form.

4. (a) For the matrix $A = \begin{bmatrix} 1 & 2 & 3 & -2 \\ 2 & -2 & 1 & 3 \\ 3 & 0 & 4 & 1 \end{bmatrix}$ find the non-singular matrices $P$ and $Q$ such that $PAQ$ is in normal form.

(b) With the help of matrix, solve the system of equations:

$$
\begin{align*}
x + y + z + t &= 5 \\
2x + y + 3z - t &= 14 \\
3x + 3y - 2z + 2t &= 1 \\
4x - 2y + z - 3t &= 6
\end{align*}
$$
SECTION - B

There are FOUR questions in this section. Answer any THREE.

5. (a) Find the linear transformation which will transform the following quadratic form into a sum of squares and find the reduced form:

\[ q = 4x_1^2 + 3x_2^2 + x_3^2 - 8x_1x_2 - 6x_1x_3 + 4x_2x_3 \]

Also find the rank, index and signature.

(b) Find the eigen-values and the corresponding eigen vectors of the matrix

\[
\begin{pmatrix}
3 & -1 & 1 \\
-1 & 5 & -1 \\
1 & -1 & 3
\end{pmatrix}
\]

6. (a) From the following frequency distribution for the weight of 100 students, find the first four moments of the distribution about 65. Also find the coefficient of skewness and Kurtosis of the distribution.

<table>
<thead>
<tr>
<th>wt in kg</th>
<th>60-62</th>
<th>63-65</th>
<th>66-68</th>
<th>69-71</th>
<th>72-74</th>
</tr>
</thead>
<tbody>
<tr>
<td>number of students</td>
<td>5</td>
<td>18</td>
<td>42</td>
<td>27</td>
<td>8</td>
</tr>
</tbody>
</table>

(b) There are 6 positive and 8 negative numbers. Four numbers are chosen at random without replacement and then multiplied. What is the probability that the product is a positive number?

(c) A and B play 12 games of chess of which 6 are won by A, 4 are won by B and 2 end in a tie. They agree to play a tournament consisting of 3 games. Find the probability that (i) A wins all three games (ii) A and B win alternately (iii) B wins at least one game.

7. (a) A district attorney (DA) is deciding on strategy for considering a plea bargain. The D.A. knows that the jurors make a correct vote for guilt or innocence about 79% of the time. There are twelve jurors, who vote independently, and it takes a vote of at least ten to convict. Use Binomial distribution to find the probability that at least ten jurors will reach a correct decision.

(b) The distribution of typing mistakes committed by a typist is given below. Fit a Poisson distribution to the data and hence calculate the expected frequencies.
(c) The mean life time of a sample of 100 fluorescent light bulbs produced by a company is computed to be 1570 hours with a standard deviation of 120 hours. The company claims that the average life of the bulbs produced by it is 1600 hours. Using the level of significance of 0.05, is the claim acceptable? (Given that at 0.05 the level of significance, $t = 1.96$).

8. (a) A state compiles statistics on deer hunters and deaths in the deer population each year. For a period of ten years, these are given by the following table:

<table>
<thead>
<tr>
<th>No. of hunters: $x$</th>
<th>168</th>
<th>172</th>
<th>194</th>
<th>204</th>
<th>230</th>
<th>270</th>
<th>295</th>
<th>320</th>
<th>390</th>
<th>402</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deaths in Deer population: $y$</td>
<td>28</td>
<td>30</td>
<td>36</td>
<td>39</td>
<td>42</td>
<td>50</td>
<td>46</td>
<td>57</td>
<td>61</td>
<td>62</td>
</tr>
</tbody>
</table>

(i) Decide whether there is a significant linear correlation between $x$ and $y$ values. (Given that the theoretical value is 0.632)

(ii) Determine the equation of the regression line of $y$ on $x$.

(iii) Estimate the percentage of the deaths in the deer population that could be explained by the number of hunters.

(b) A population consists of the five numbers 2, 3, 6, 8, 11. Consider all possible samples of size two which can be drawn with replacement from this population. Find

(i) the mean of the population.

(ii) the standard deviation of the population.

(iii) the mean of the sampling distribution of means.

(iv) the standard deviation of the sampling distribution of means, i.e. the standard error of means.